

WHAT IS CLAIMED IS:

1. A pumping device comprising a substrate having walls which define a microchannel, a first electrode, and a second electrode, wherein said first and second electrodes are positioned to form a first capacitor having an electric field that traverses the microchannel, and wherein the microchannel contains a first fluid and a second fluid between the electrodes, said first and second fluids having a first interface therebetween and said first and second fluids having different dielectric constants such that the first interface between said fluids moves in the presence of the electric field.
2. A pumping device according to claim 1, wherein the first electrode is configured to have a first potential applied to a first end of the electrode and a second potential applied to a second end of the electrode.
3. A pumping device according to claim 2, wherein the second electrode is configured to have a third potential applied to said electrode, wherein the third potential is greater than said first potential, and wherein the third potential is less than said second potential.
4. A pumping device according to claim 1 wherein the microchannel is a continuous channel.
5. A pumping device according to claim 4 wherein said microchannel has a tapered portion having a fluid interface therein.
6. A pumping device according to claim 1 wherein the microchannel is a discontinuous channel having a first end and a second end.
7. A pumping device according to claim 1 wherein the microchannel has at least one reservoir in fluid communication with the microchannel.
8. A pumping device according to claim 7 wherein said reservoir contains said first fluid, wherein said first fluid is a liquid, wherein said reservoir is sealed, and wherein said reservoir further contains a gas.

9. A pumping device according to claim 1 wherein the substrate defines flow-restricting indentations into the microchannel having a size sufficient to restrain flow of a liquid through the microchannel.

10. A pumping device according to claim 1 wherein a portion of the walls forming the microchannel has a coating applied thereon of sufficient hydrophobicity that the coating restrains flow of a polar liquid through the microchannel.

11. A pumping device according to claim 1 wherein the first fluid and the second fluid are liquids.

12. A pumping device according to claim 1 wherein the microchannel contains a third fluid in a portion of the microchannel that is not immediately between said first and second electrodes.

13. A pumping device according to claim 12 wherein the third fluid contains a biological molecule.

14. A pumping device according to claim 12 wherein the third fluid comprises a drug.

15. A pumping device according to claim 12 wherein the third fluid has a refractive index suitable for a core or cladding of an optical telecommunications device.

16. A pumping device according to claim 1 and further comprising a third electrode and a fourth electrode positioned to form a second capacitor having an electric field that traverses the microchannel.

17. A pumping device according to claim 16, wherein the third electrode is configured to have a first potential applied to a first end of said electrode and a second potential applied to a second end of said electrode.

18. A pumping device according to claim 1 wherein a first portion of the microchannel has a cross-sectional area that is greater than a cross-sectional area of a second portion of the microchannel.

19. A pumping device according to claim 18 wherein said microchannel has a third portion that tapers between said first portion and said second portion.

20. A pumping device according to claim 19 wherein said microchannel has a second fluid interface positioned in said third portion.

21. A method of moving a first fluid in a microchannel, said method comprising placing an interface formed by said first fluid and a second fluid in an electric field generated by a capacitor having a first plate at a first potential and a second plate at a second potential, wherein said first fluid and said second fluid have sufficiently dissimilar dielectric constants that said interface moves in the presence of said electric field.

22. A method according to claim 21 wherein the act of placing the second plate at a second potential comprises placing a first end of the second plate at the second potential and placing a second end of the second plate at a third potential, said second potential being greater than said first potential and said third potential being less than said first potential.

23. A method according to claim 22 wherein the method further comprises changing at least one of said first, second, and third potentials to move said interface a second time.

24. A method according to claim 21 wherein said method further comprises moving a third fluid that is in communication with said first fluid.

25. A method of using dielectric pumping, said method comprising moving a fluid volume within a microchannel in an optical telecommunications device.

26. A method of using dielectric pumping, said method comprising moving a fluid volume within a microchannel to react or analyze a biological or chemical sample.